

RESTRICTED CIRCULATION

This paper is not an official document; it is for information only and reference cannot be made to it in any printed publication without the permission of the author.

AGRICULTURAL MEMORANDUM NO 418 DR M HOUGH

BARLEY RIPENING AND THE WEATHER - EUROPEAN COUNTRIES

When the methods devised for Sparsholt (Ag Memo 412) were applied to barley ripening data from other countries, little success was achieved. In particular, the duration from sowing to ear emergence was not well correlated with the ear emergence to dead ripeness time for trials held in diverse climates (Spain, Italy, Sweden and Ireland). The number of raindays towards the end of ripening which was useful at Sparsholt was poorly related to ripening in other countries.

Growth Chamber Studies

Paquet (1968) showed that high temperatures during the early stages of grain filling accelerated the protein accumulation in wheat grains, but only had a small effect at other times. It is also to be expected that the final stages of the change in grain moisture will depend upon potential transpiration at that time. Therefore the mean rate of ripening could be related to the mean daily air temperature during the 14-20 days following ear emergence and the mean daily potential transpiration during the 14-20 days before dead ripeness. Data from England, Ireland, Sweden and Italy (30 sets of values) were chosen and gave a correlation coefficient of 0.82.

The first part of grain swelling requires energy for protein synthesis and cell enlargement. This would usually be obtained by respiration of the plant's carbohydrate supply synthesised by the leaves and awns. In turn this depends upon the weather, particularly the amount of light, and so the potential transpiration should logically be a better physical variable to use than temperature. The correlation between the mean rate of ripening and the mean daily potential transpiration between ear emergence and dead ripeness for England, Ireland, Sweden and Italy is 0.83.

Data from All Countries

The graph shows the mean rate of ripening plotted against the mean daily potential transpiration between ear emergence and dead ripeness for the following countries: England, Ireland, France, Sweden, Denmark, Finland, Germany, Austria, Belgium, Holland, Italy, Switzerland, Spain and Portugal (75 sets of values). Three observations appear different from the others (England, 1959, and two from Spain, 1963); omitting these anomalies, the correlation is 0.75, and the regression equation is

$$1 / D = 0.0052 (PT) + 0.0050 \text{ ————— (1)}$$

Where D is the number of days between ear emergence and dead ripeness, and PT is the daily mean potential transpiration (mm per day) between ear emergence and dead ripeness.

A similar correlation between $1 / D$ and the mean air temperature during ripening gave a coefficient of only 0.62.

There is some suggestion of a systematic variation according to country. In particular Finland, and in some years Sweden, appear to ripen far quicker than other countries. This could be a human error factor or may be due to the longer days which favour more rapid leaf senescence.

The fine summer of 1959 in NW Europe produced some interesting results. The trials in Belgium, Holland and particularly England took longer to ripen than Sweden, Denmark or France even though the potential transpirations in these countries were similar. No ready explanation can be found.

Errors

Potential transpiration was estimated from

$$PT = \frac{0.75 (0.23 + 0.48 n/N) \Delta/\gamma}{1 + \Delta/\gamma} RA$$

Where n is the mean number of sun hours per day and N the daylength, the other symbols have their usual meanings. The net long wave radiation and aerodynamic terms were assumed to cancel. The consequent error in PT is likely to be about 5%.

The observational error in the date of ear emergence is probably about one day, but the estimation of dead ripeness may be open to greater error. In the northern countries (Finland and Sweden), ripening is usually in August or September and the over-riding necessity to harvest before autumn sets in may lead to the estimation of a shorter ripening time. Similarly a "hastening" factor may apply in Italy and Spain, so that harvesting can occur before excessively high temperatures damage the grain. By contrast "delay" factors may operate in England and the low countries where an unusually early year (eg 1959) may be missed.

Forecasting Application

Assuming a forecast of potential transpiration (or sun hours) is available then equation (1) allows an estimate of D to be made within a mean error of about 7 days for $D = 50$ days, decreasing to 3 days for $D = 30$ days.

In some countries this is not much better than the assumption of a mean duration of ripening. For England the mean error in D caused by the use of the mean ripening duration is 5.6 days. Equation (1) estimates D to within a mean error of 5.4 days. A possible approach to achieve greater accuracy would be to consider the grain filling and grain drying stages in greater detail. This will be attempted next.

Any comments or criticisms should be sent direct to the author.

Meteorological Office
Met O 8a
London Road
BRACKNELL
Berks RG12 2SZ

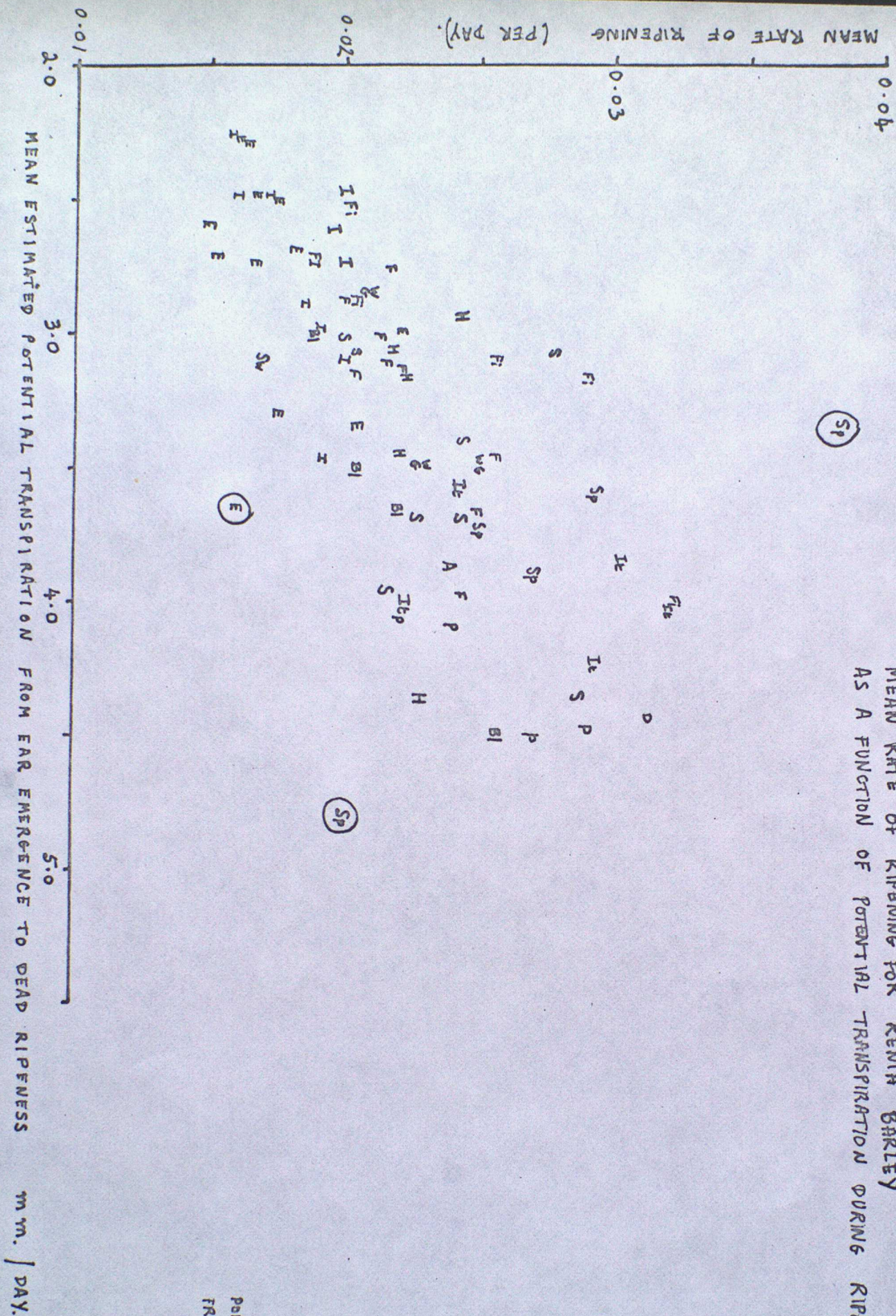
December 1971

15336/LBN/12/71/70

Reference

Paquet, J. 1968. Effects of a sharp rise in temperature on protein accumulation in the grain of soft wheat. *Ann Amelioration Plantes*, 18 (1) : 17-27

MEAN RATE OF RIPENING FOR KENIA BARLEY
AS A FUNCTION OF POTENTIAL TRANSPIRATION DURING RIPENING.



P POINTS THUS: (E) ARE OMITTED FROM THE REGRESSION ANALYSIS.